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MEMORANDUM

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TO: Linda Ader, Project Manager, Ecology and Environment, Inc., Seattle, WA

FROM: Mark Woodke, START QA Chemist,
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SUBJ: Freeman Ground Water Contamination, TDD: 14-09-0004
2014 Site Inspection Calculated Correlation Coefficient for Carbon Tetrachloride

A correlation analysis between field laboratory results and fixed laboratory results was performed on carbon tetrachloride data generated for the Freeman Ground Water Sampling Site Inspection (SI). For the purposes of the correlation analysis, non-detect sample results (i.e., those with a "U" data qualifier) were divided by 2. This technique split the difference between using the sample quantitation limit value (which may potentially introduce a high bias) and using zero (which may potentially introduce a low bias).

The correlation between the two data sets was determined using the following correlation coefficient (r) formula:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Where:

Σ	is Sigma, the symbol for "sum up"
$(x_i - \bar{x})$	is each x-value minus the average of x
$(y_i - \bar{y})$	is each y-value minus the average of y

The correlation values (i.e., x and y values) use in this formula are provided in Table 1. Using this correlation coefficient formula, the correlation coefficient (r) between the two data sets was calculated to be 0.889, just below the (r) limit of >0.900 required for the field data to be considered "definitive," but well above (r) limit of >0.700 required for the field data to be considered as "screening data with definitive confirmation." "Definitive" data is analytical data of sufficient quality for final decision-making and is suitable for determining the extent of contamination or cleanup confirmation. "Screening level data with definitive confirmation" is analytical data that may be used to support preliminary or intermediate decision-making until confirmed by definitive data; however, even after confirmation, this data is often not as precise as definitive data. (EPA 2006)

Based on the correlation coefficient value achieved [i.e., (r) of 0.889] for field data generated under the Freeman Ground Water Contamination SI, this field data was confirmed by the fixed laboratory data and can be used for final decision-making purposes.

Citations:

EPA (United States Environmental Protection Agency), January 2009, *EPA Guidance for Labeling Externally Validated Laboratory Data for Superfund Use*, EPA 540-R-08-005, OSWER No. 9200.1-85.

Table 1 Field vs. Fixed Laboratory Correlation Values for Carbon Tetrachloride Soil Sample Results

Carbon Tetrachloride		Field Results (µg/kg)		Laboratory Results (µg/kg)	
Sample Number	Sample Depth (feet bgs)	Original Result	Correlation Value (x)	Original Result	Correlation Value (y)
BK01SB03	2.5 - 3	2.10 U	1.05	4.7 U	2.35
BK01SB04	3.5 - 4	2.15 U	1.08	4.9 U	2.45
BK01SB12	11.5 - 12	1.87 U	0.94	4.7 U	2.35
HA01SB13.5	13 - 13.5	2.49 U	1.24	6.2 U	3.10
HA02SB2.5	2 - 2.5	2.14 U	1.07	5.5 U	2.75
HA03SB09	8.5 - 9	2.37 U	1.19	4.7 U	2.35
SB01SB1.5	1 - 1.5	2.12 U	1.06	4.3 U	2.15
SB01SB05	4.5 - 5	2.38 U	1.19	5.1 U	2.55
SB04SB04	3.5 - 4	2.51 U	1.26	6 U	3.00
SB04SB05	4.5 - 5	2.33 U	1.16	0.21 JQ	0.21
SB06SB4.5	4 - 4.5	2.48 U	1.24	5.1 U	2.55
SB06SB6.5	6 - 6.5	2.36 U	1.18	4.5 U	2.25
SB06SB12	11.5 - 12	2.85 U	1.42	6 U	3.00
SB09SB15	14.5 - 15	5.14 U	2.57	3.2 JQ	3.2
SB09SB19.5	19 - 19.5	**4.88**	4.88	3.8 JQ	3.8
SB09SB25	24.5 - 25	**3.83**	3.83	3.2 JQ	3.2
SB10SB15.5	15 - 15.5	3.15 U	1.57	0.88 JQ	0.88
SB10SB18.5	18 - 18.5	**5.21**	5.21	6.5 JQ	6.5
SB10SB20.5	20 - 20.5	**5.06**	5.06	4.4 JQ	4.4
SB11SB18.6	18.2 - 18.6	2.96 U	1.48	1.4 JQ	1.4
SB11SB20	19 - 20	**3.21**	3.21	1.9 JQ	1.9
SB11SB21.5	21 - 21.5	**4.37**	4.37	1.7 JQ	1.7
SB11SB28	27.5 - 28	**4.42**	4.42	0.71 JQ	0.71
SB11SB32	31.5 - 32	**3.67**	3.67	7.5 U	3.75
SB12SB20	19.5 - 20	3.46 U	1.73	2.3 JQ	2.3
SB12SB21.5	21 - 21.5	3.18 U	1.59	1.9 JQ	1.9
SB12SB28.5	28 - 28.5	**2.85**	2.85	0.19 JQ	0.19
SB13SB14	13.5 - 14	2.53 U	1.27	1.2 JQ	1.2
SB13SB20	19 - 20	**7.98**	7.98	4.1 JQ	4.1
SB13SB21.2	20.8 - 21.2	**8.42**	8.42	**9.7**	9.7
SB13SB23	22 - 23	**5.92**	5.92	7.1 JQ	7.1
SB13SB27.5	26.5 - 27.5	**6.42**	6.42	4.9 JQ	4.9
SB13SB30	29.5 - 30	**14.98**	14.98	**15**	15
SB14SB18	17.5 - 18	**5.86**	5.86	6.8 JQ	6.8
SB14SB21.5	21 - 21.5	**9.3**	9.3	**9.3**	9.3
SB14SB23.5	23 - 23.5	**10.67**	10.67	9.8 JQ	9.8
SB14SB28	27.5 - 28	2.66 U	1.33	0.27 JQ	0.27

Note: Bold values are greater than the sample quantitation limit.

Key:

µg/kg =	micrograms per kilogram.
bgs =	below ground surface.
JQ =	The result is estimated because the concentration is below the Contract Required Quantitation Limits.
U =	The associated sample result is less than the listed quantitation limit.